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SIMULATION AND ANALYSIS PROSTHETIC LEG

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ABSTRACT

In our society we see some handicapped people they are not like a normal person. Those are injured by an accident or handicapped by birth. Those people are not in a position of doing our regular things like a normal person. Prosthesis is to be used for those kinds of people. Prosthesis is like a created organ or an artificial body part that should be placed in a missing body part.

The motion of a shank at the knee joint of prosthesis has been modeled mathematically by considering all the dimensions of a normal human. The motion of a normal human knee joint has been simulated with the help of Adams software. The results are analyzed by considering the forces that act on the feet while walking (usually known as reaction forces of ground). From the obtained results, it can be said that thus simulated prosthetic mechanism is suitable for all the people irrespective of age and weight.

Key words: artificial body, handicapped people, Dassault Systems, Solid works, 3D modeling, Adams software.

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1. INTRODUCTION

This article is mainly focused on presenting an artificial leg that is made with the help of a mechanism that employs a usual worm gear. This mechanism is employed by placing a usual worm gear at the knee joint which helps for the movement of leg commonly known as prosthetic. Prosthesis means an artificial body part or device that replaces a missing body part. This mechanism is carried out by using 3-12 volts battery, 60 rpm motor, worm gear and spur gear.

2. THEORY

For generating the movement at knee joint we mainly used two types of gears. They are worm gear and spur gear. Worm gear is a mechanical device in this a cylindrical shaft of a screw threaded region is meshed with toothed wheel which helps for converting one direction of rotation to another direction of motion perpendicular to the direction of worm shaft rotation. The main parameter that should be considered from this setup is, change in displacement at the end portion of prosthesis leg.

Generally, a normal human leg cannot give complete rotation. It can be moved/ rotated only up to certain limit/range for Maintaining that limited/fixed displacement of normal human leg, gears are fixed accordingly.

Figure 1 Handicapped people

3. MECHANISM

The mechanism is driven by the motor which has been connected to the worm or driver shaft such that when power is given to the motor shaft also rotates along with motor. The gear which is in connection with the worm gear or shaft also rotates. The shaft which maintains the connection between the gear and the leg at the knee joint is termed as output shaft or driven shaft which helps in transferring the motion to the leg. A metallic rod is placed in between the knee joint and the ground to maintain a fixed distance. This rod converts the rotational motion to the change in displacement.

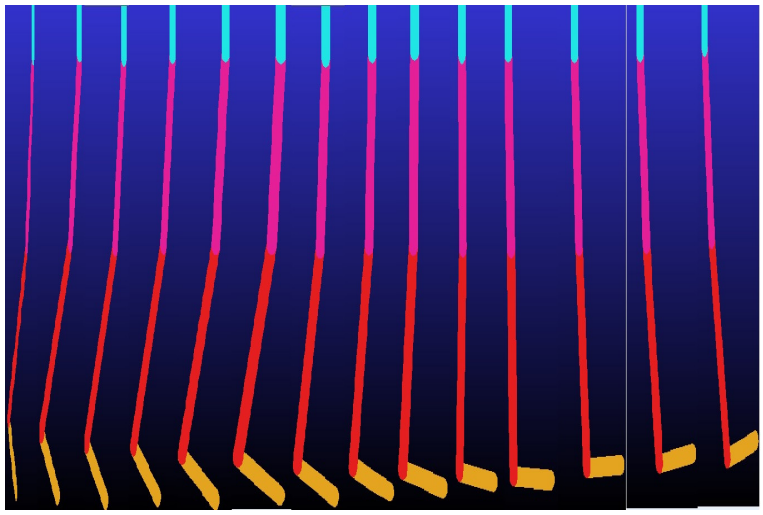

Figure 2 This picture shows that while moving person change in positions of his leg

4. MODELING

The prototype has been modeled by using Solid works software. Solid works is design software launched by Dassault Systems. In this software, we can design solid objects in 3D modeling. The rotational motion at the knee joint is analyzed by the Adams software. We used Adams software as it helps in getting the simulation motion analysis.

5. CALCULATION

Verification of how much displacement is generated at the foot By considering the 60 rpm motor, 12 volts battery. Teeth of spur gear is 60, Gear ratio is 60. In this, we know how much rpm can be generated at driven shaft. We know that

N1/N2 = T1/T2

Where N1 means driver shaft rpm (initially given rpm),

N2 be the final rpm generated at the driven shaft,

T1/T2 be the gear ratio = 60.

Finally the rpm that should be generated at the driven shaft is 1 which means that the leg will rotates one complete rotation.

Here we don't have complete rotation because a normal person can move the leg for some extent deviation only. Let us assume a normal person can displace his leg with an angle of 120 degrees deviation.

$$\frac{360}{N1} = \frac{120}{X}$$

Here, X be the required minimum rpm.

The amount of torque generated at the gear is No load current = 20mA,

Full load current = 800mA

Torque (T) = Php * 60325/N

(Or)

Torque (T) = Pw* 9.549/N

P_{hp} be the horse power of the motor

P_w be the power of motor.

T = (9.6 * 9.549)/60 =1.529 $_{N-m}$

$$T = \frac{(9.6 * 9.549)}{60}$$

$$T = 1.529_{N-m}$$

6. GRAPHS ARE OBTAINED BY USING ADAMS SOFTWARE

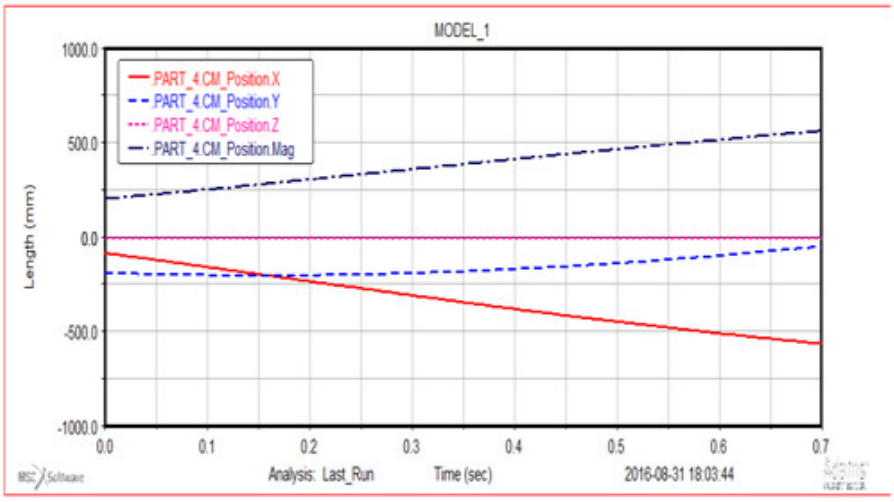

Figure 2 This graph shows that distance with respect to time taken while moving in all x, y and z direction of a knee.

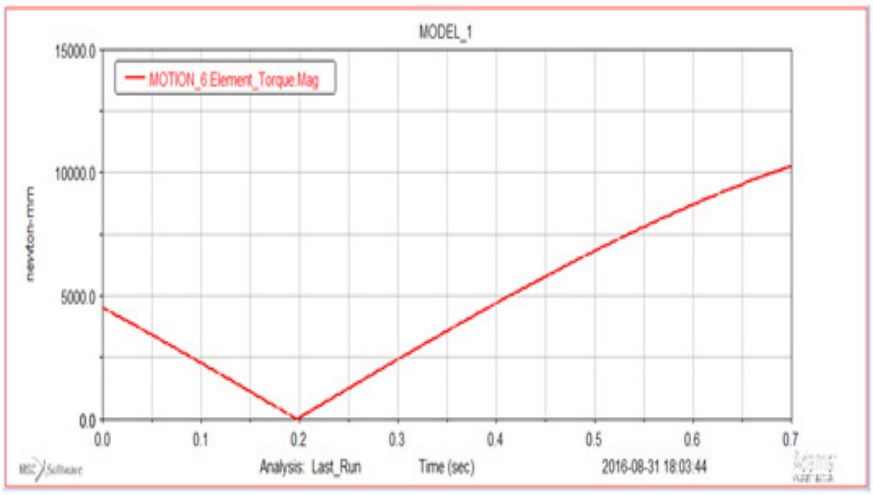

Figure 3 This graph shows that displacement with respect to time taken of foot portion.

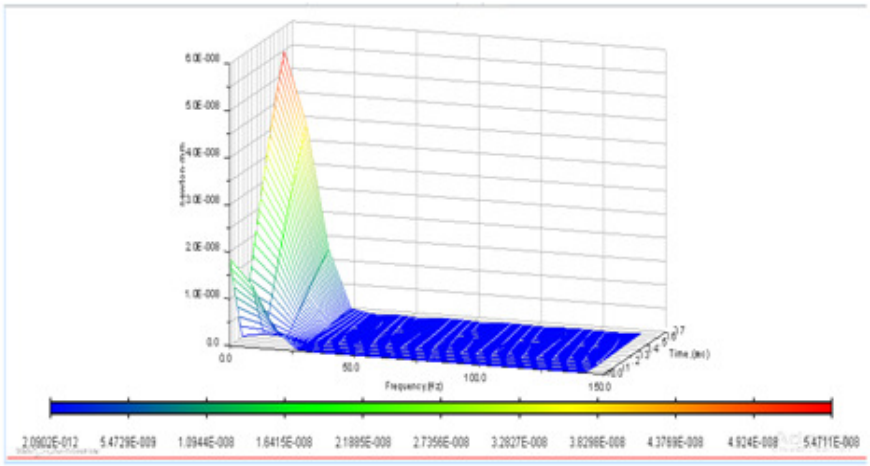

Figure 4 This graph shows that displacement of a knee joint with respect to frequency if motion.

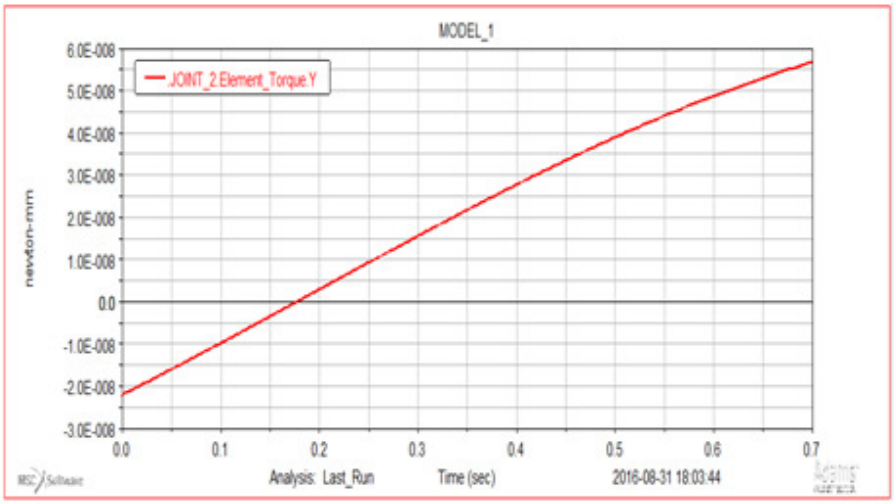

Figure 5 This graph shows that torque acting on element in y direction.

REFERENCES

[1] Kalyana Chakravarthy Y, PavanKishore N, Ashok N, Manoj M, Mithun Chakravarty A, Srinath A, Virtual Prototyping and Analysis of a Robotic Prosthetic Leg, The International Daily journal ISSN 2278 – 5469 EISSN 2278 – 5450© 2015 Discovery Publication.

[2] Ganesan.H, Mohankumar. G, Study on Optimization of Machining Parameters in Turning Process Using Evolutionary Algorithm with Experimental Verification. *International Journal of Mechanical Engineering and Technology (IJMET),* 2 (1), 2011, pp. 10–21.

[3] K. Chaitanya, Y.Kalyan Chakravarthy, A.Srinath, K. Rajasekhara Rao, Hydraulic Prosthetic Knee Mechanism with Neural Network Interphase.

[4] Y. Kalyana Chakravarthy & D.Suneel, D.lingaraju, Alternate materials for Modeling and Analysis of Prosthetic Knee joint, international Journal of Science and Advanced Technology (ISSN 2221-8386), Volume 1 No 5 July 2011.

[5] Subhash Chandra Namdeo, Dynamic Analysis and Optimization of Process Parameters in Turning Operation by Using Adams Software. *International Journal of Design and Manufacturing Technology*, 7 (2), 2016, pp. 14–31.

[6] Dr. R. P. Sharma and Chikesh Ranjan, Modeling a nd Simulation of Four-Bar Planar Mechanisms Using ADAMS. *International Journal of Mechanical Engineering and Technology*, 4 (2), 2013, pp. 429–435.